SCIENCE

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FRIDAY, JUNE 23, 1899.

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☞ MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson N. Y.

UNITED STATES NAVAL OBSERVATORY.

ASTRONOMERS everywhere will be gratified by the announcement from Washington that Secretary Long has appointed a board to visit, examine and report upon the U. S. Naval Observatory. The work of this body will be of such far-reaching importance—perhaps determining the character of our government astronomy for fifty years to come—as to make it worthy of the serious consideration of the public. Whether it shall prove as nugatory as the efforts heretofore made to improve the administration must depend upon the wisdom with which the board executes its difficult and delicate task.

We believe a grave mistake will be made if the board confines itself to matters of detail and merely points out the features in which the administration can be improved. We have had plenty of such criticism in the past and always without any important result. The subject should be approached from a broader point of view, taking in its scope the whole history of the institution, past and prospective. What we are concerned with are the work and results of the most richly endowed and liberally supported astronomical observa-

tory in the world. The funds for its support come from the pockets of our taxpayers, and the latter, speaking through our astronomers as their mouthpiece, should be satisfied with nothing less than that the work done by the institution shall correspond to the liberality with which they are supporting it. The fact that our country has a larger proportion of the ablest astronomers of the world than any other, not excepting even Germany, leaves us without any excuse if our national observatory fails to be completely up to the present time.

For more than fifty years we have been trying an experiment in astronomical administration which no other nation ever thought of trying and which we ourselves have never tried in any other field, that of managing a great national observatory like a naval station. One of the most important questions is whether this experiment, taking the whole fifty years together, can be called a success. This question can be answered only by a critical examination of the work of the institution, as found in its volumes of published observations and official reports. In this connection it will be wise to review the laudable efforts made from time to time to improve the administration and determine the causes of their success or failure.

When the subject is considered from this point of view it is a serious question whether any other than an adverse conclusion can be reached. It is true that excellent work has now and then been done at the observatory and that this, taken in connection with the favorable impression made by the splendor of its new buildings, prepossesses the public, which never looks below the surface in its favor. But, as was very clearly pointed out by the National Academy of Sciences in a report in 1885, this good work has been mostly the voluntary work of individuals who happened to be attached to the institution and acted on their own initiative. The part of the administration was only to get the men together and procure them facilities for work.

It should also be remembered that even this work is not by any means a permanent feature of the institution. If we take away from the latter such work as that of Seers Cook Walker in investigating the motions of Neptune, and of Professor Asaph Hall in discovering the satellites of Mars and in investigating the motions of other satellites, what have we left? If anything but a heterogeneous collection of observations and researches, sometimes intermitted entirely and sometimes carried on with vigor, sometimes devoted to one object, sometimes to another, sometimes able and sometimes useless, generally of the most perfunctory kind, nearly always with more or less imperfect instruments and with little evidence of any concerted plan, we hope the board will find it out.

An excellent text will be found in the recent catalogue of stars by Professor Eastman, which, we are told in the preface, has occupied two-thirds of the observatory force for a period of more than thirty years. What should the committee say when it compares the unflagging zeal and persistence of the author with the imperfections of the instrument he had to use?

In the same class may come the more re-

cent work of Professor George A. Hill with the prime vertical transit. There can be no question of the zeal and industry with which Mr. Hill has for five years continued a series of observations bearing on one of the most important problems in exact astronomy with which we are dealing to-day. Yet the results of his work so far as published show now and then anomalies and irregularities leading to the suspicion that there is something wrong about the instrument. The cause can be found only by critical investigation. It would certainly be very regrettable if such rare qualities as those of Mr. Hill should fail to be productive of their best results through adverse circumstances which would be speedily remedied under a proper system of administration; and we hope the Committee will either demonstrate that the suspected defects of the work are unreal, or show their cause if they exist.

THE DIFFRACTION PROCESS OF COLOR PHOTOGRAPHY.

THE production of color by photography has been accomplished in two radically different ways up to the present time. In one, the so-called Lippman process, the waves of light form directly in the photographic film laminæ of varying thickness, depending on the wave-length or color of the light. These thin laminæ show interference colors in reflected light in the same way that the soap bubble does, and these colors approximate closely the tints of the original. The technical difficulties involved in this process are so great that really very few satisfactory pictures have ever been made by it. The other, or three-color process, has been developed along several distinct lines; the most satisfactory results having been produced by Ives with his stereoscopic 'Kromskop,' in which the reproduction is so perfect that in the case of still-life subjects it would be almost impossible to distinguish between the picture and the original seen through a slightly concave lens. The theory of the three-color method is so well known that it will be unnecessary to devote any space to it, except to remind the reader of the two chief ways in which the synthesis of the finished picture is effected from the three negatives. We have, first, the triple lantern and the Kromscope, in which the synthesis is optical, there being a direct addition of light to light in the compound colors, yellow being produced, for example, by the addition of red and green. The second method is illustrated by the modern trichromic printing in pigments. Here we do not have an addition of light to light, and, consequently, cannot produce yellow from red and green, having to produce the green by a mixture of yellow and blue. Still a third method, that of Joly & McDonough, accomplishes an optical synthesis on the retina of the eye, the picture being a linear mosaic in red, green and blue, the individual lines being too fine to be distinguished as such.

The diffraction process, which I have briefly described in the April number of the London, Edinburgh and Dublin *Philosophical Magazine*, is really a variation of the three-color process, though it possesses some advantages which the other methods do not have, such as the complete elimination of colored screens and pigments from the finished picture, and the possibility of printing one picture from another. The idea of using a diffraction grating occurred to me while endeavoring to think of some way of impressing a surface with a structure capable of sending light of a certain color to the eye, and then superposing on this a second structure capable of sending light of another color, without in any way

interfering with the light furnished by the first structure. This cannot, of course, be done with inks, since if we print green ink over red the result will not be a mixture of red light and green light, but almost perfect absence of any light whatever; in other words, instead of getting yellow, we get black. Let us consider, first, how a picture in color might be produced by diffraction. Place a diffraction grating (which is merely a glass plate with fine lines ruled on its surface) before a lens, and allow the light of a lamp to fall upon it. There will be formed, on a sheet of paper placed in the focal plane of the lens, an image of the lamp flame, and spectra, or rainbow-colored bands, on each side of it. Now, make a small hole in the sheet of paper in the red part of one of these spectra. This hole is receiving red light from the whole surface of the grating; consequently, if we get behind the paper and look through the hole we shall see the grating illuminated in pure red light over its whole extent. This is indicated in Fig. 1, where we have the red

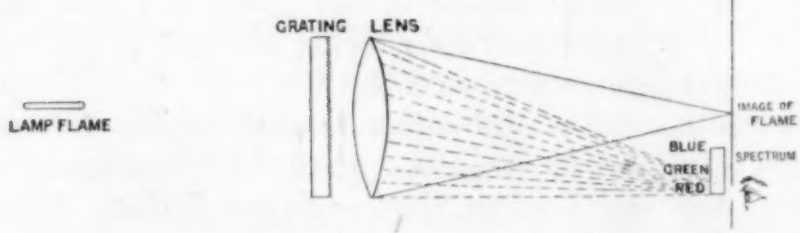

Fig. 1.

end of the spectrum falling on the hole, the paths of the red rays from the grating to the eye being indicated by dotted lines. Now, the position of the spectra, with reference to the central image of the flame, depends on the number of lines to the inch with which the grating is ruled. The finer the ruling the farther removed from the central image are the colored bands removed. Suppose, now, we remove the grating in Fig. 1, and substitute for it one with closer ruling. The spectrum will be a little lower down in the diagram, and, instead of the red falling on the hole, there will be green; consequently, if we look through the hole we shall see this grating illuminated in green light. A still finer ruling will give us a grating which will appear blue. Now, suppose that the two first gratings be put in front of the lens together, overlapping, as shown in Fig. 2. This

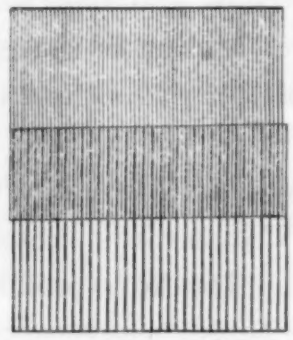

Fig. 2.

combination will form two overlapping spectra, the red of the one falling in the same place as the green of the other, namely, on the eye-hole. The upper strip, where we have the close ruling, sends green light to the eye and appears green; the under strip, with the coarser ruling, sends red light to the eye and appears red; while the middle portion, where we have both rulings, sends both red and green light to the eye, and in consequence appears yellow, since the simultaneous action of red and green light on any portion of the retina causes the sensation of yellow. In other words, we have, in superposed diffraction gratings, a structure capable of sending several colors at once to the eye.

If we add the third grating we shall see the portion where all three overlap illuminated in white, produced by the mixture of red, green and blue light.

Three gratings, with 2,000 lines, 2,400 lines and 2,750 lines to the inch, will send red, green and blue light in the same di-

rection, or, in other words, to the same spot on the screen behind the lens.

FIG. 3.

Suppose, now, we have a glass plate with a design of a tulip, with its blossom ruled with 2,000 lines to the inch, its leaves ruled with 2,400 and the pot in which it is growing ruled with 2,750 lines, and place this plate before the lens. On looking through the hole we shall see a red tulip with green leaves growing in a blue pot. Thus we see how it is possible to produce a colored picture by means of diffraction lines, which are in themselves colorless. Those portions of the plate where there are no lines send no light to the eye and appear black.

We have, now, to consider how this principle can be applied to photography. That photographs which show color on this principle can be made depends on the fact that a diffraction grating can be copied by contact printing in sunlight on glass coated with a thin film of bichromated gelatine. The general method which I have found best is as follows. Three gratings ruled on glass with the requisite spacing were first prepared.* To produce a picture in color, three negatives were taken through red, green and blue color filters in the usual manner. From these three ordinary lantern-slide positives were made. A sheet of thin plate glass was coated with chrom gelatine, dried, and cut up into pieces of suitable size; one of these was placed with the sensitive film in contact with the ruled surface of the 2,000-line grating, and the whole covered with the positive representing the action of the red light in the picture. An exposure of thirty seconds to sunlight impressed the lines of the grating on the film in those places which lay under the transparent parts of the positive. The second grating and the positive representing the green were now substituted for the others and a second exposure was made. The yellows in the picture being transparent in both positives, both sets of lines were printed superposed in these parts of the picture, while the green parts received the impression of 2,400 lines to the inch only.

The same was done for the blue, and the plate then washed for a few seconds in warm water. On drying it appeared as a colored photograph when placed in front of the lens and viewed through the hole in the screen. Proper registration during the triple printing is secured by making reference marks on the plates. A picture of this sort once produced can be reproduced indefinitely by making contact prints, since the arrangement of the lines will be the same in all of the copies as in the original. The finished picture is perfectly transparent and is merely a diffraction grating on gelatine with variable spacing. In some parts of the picture there will be a double grating, and in other parts (the whites) there will be a triple set of lines. Having had some difficulty in getting three sets of lines on a single film in such a way as to produce a good white, I have adopted the method of making the red and green gratings on one plate and the blue on another, and then mounting the two with the films in contact. It is very little trouble to multiply the pictures once the original red-green grating picture is made.

The pictures are viewed with a very simple piece of apparatus shown in Fig. 4,

*These gratings were ruled for us on the dividing engine at Cornell University, through the courtesy of Professor E. L. Nichols.

consisting of a lens cut square like a reading glass, mounted on a light frame provided with a black screen perforated with an eye hole through which the pictures are viewed.

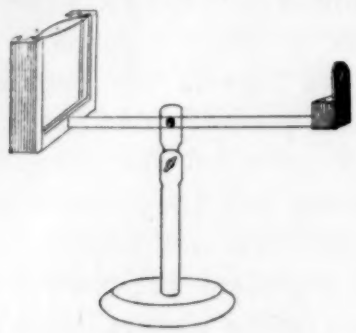

FIG. 4.

The colors are extremely brilliant, and there is a peculiar fascination in the pictures, since, if the viewing apparatus be slowly turned so that its direction with reference to the light varies, the colors change in a most delightful manner, giving us, for example, green roses with red leaves, or blue roses with purple leaves, a feature which should appeal to the impressionists. The reason of this kaleidoscopic effect is evident, for, by turning the viewing apparatus, we bring the eye into different parts of the overlapping spectra.

It is possible to project the pictures by employing a very intense light and placing a projecting lens in place of the eye behind the perforation in the screen. Of course, a very large per cent. of the light is lost; consequently great amplification cannot well be obtained. I have found that sunlight gives the best results, and have thrown up a three-inch picture on a four-foot sheet, so that it could be seen by a fair-sized audience.

By employing a lens of suitable focus it it possible to make the viewing apparatus binocular, for similar sets of superposed spectra are formed on each side of the central image by the gratings, so that we may have two eyeholes if the distance between the spectra corresponds to the interocular distance.

It is interesting to consider that it is theoretically possible to produce one of these diffraction pictures directly in the camera on a single plate. If a photographic plate of fine grain were to be exposed in succession in the camera under red, green and blue screens, on the surfaces of which diffraction gratings had been ruled or photographed, the plate on development should appear as a colored positive when seen in viewing apparatus. I have done this for a single color, but the commercial plates are too coarse-grained to take the impression of more than a single set of lines. With specially-made plates I hope to obtain better results.

R. W. Wood.

University of Wisconsin.

THE MENTAL FATIGUE DUE TO SCHOOL WORK.

The meaning of the results obtained by the different investigators of fatigue among school children has been much confused because either the experimenter has not proved that what he measured was fatigue at all or has so arranged his experiments that the influence of practice on the one hand, and of unwillingness and lack of interest on the other, have not been discounted. Especially when, as has so often been the case, the teacher gives the work as a part of the school routine one may be measuring only a conventional habit of the school children of doing less at a certain time of day, or an unwillingness to work due to ennui. What a person *does* do need not be a measure of what he *could* do.

The experiments a summary of which follows were devised in order to get an answer to the question: "Does the work of a school-session fatigue the pupils mentally, make them really less able to do mental work than they were at its commencement, and, if so, to what extent?"

The method was to give to a sufficient

number of scholars a certain test which would measure their ability (in a certain direction, at least) to do mental work, early in the school session, and then to give this same test to a *different* lot of children of approximately equal general maturity and ability late in the session. The influence of practice is thus entirely obviated, as the scholars do not have the same sort of work twice. In order to save the results from being vitiated by differences in the general ability of the students, four different tests were used, and the pupils who had two of these tests early had the other two late, while those who had the first two late had the other two early. The influence of possible differences in the average ability of the two sets of students can thus be estimated. In order to make sure that the willingness and interest of the pupils was a constant except in so far as due to causes outside our control, all the tests were given by myself.

The work given was: (1) a set of multiplication examples to be done in a given time; (2) a page of printed matter full of mis-spelled words which were to be marked in a given time; (3) two sets of nonsense syllables to be written from memory after a ten seconds' look at them, and (4) two sets of figures and one set of simple forms (*e. g.*, square, triangle) to be written from memory in the same way.

About 150 children (four classes) were given 1 and 3 early and 2 and 4 late. An equal number of children in the same school grade were given 2 and 4 early in the school day, the other half late. In order to eliminate the influence on the work which excitement at my first visit, or being used to me or being tired of me at my second visit, might cause, I made my first visit coincide with an early test in half the classes and with a late test in the other half. The early tests were all given between 10 minutes and 40 minutes after the opening of school in the morning, while the late tests were given between 40 minutes and 10 minutes before the close of school, half of them at the close of the morning and half at the close of the afternoon session.

Thus any general decrease in the amount or accuracy of the late work will be due to mental fatigue, or to some aversion to work caused by the school day and quite apart from the aversion to conventional routine work or to some factors yet to be demonstrated. And if there is no difference we can say with assurance that the day's work has not decreased the child's ability to work, that though he may in school do less in the latter part of the day it is not in any wise due to real exhaustion, to a lowering of his mental energy.

As a fact what difference there was between the early and late work was in favor of the *latter*. The multiplication test was given to 152 scholars early and 144 late. After reducing the amount done and mistakes made by the 152 to what would have been done by 144, and comparing the results obtained with the work of the 144 who had the test late, we find that the latter did nearly 14% more work and made less than 5% more mistakes.

The spelling work was given to 152 pupils early and 146 late. After estimating the work of 146 early pupils on the basis of what the 152 did and comparing with the 146 late, we find that the latter worked through $99\frac{7}{10}\%$ as many lines, marked about 2% more words and marked $2\frac{6}{10}\%$ more words which should have been left unmarked.

The nonsense syllables were used with 152 pupils early and 148 pupils late. When reduced to an equality in numbers the late pupils did $97\frac{5}{10}\%$ as well as the early.

The figures to be remembered were given to 152 pupils early and 145 late. When reduced to an equality in numbers the late pupils did 89% as well as the early.

In remembering the simple forms the late pupils did $94\frac{6}{10}\%$ as well as the early.

It seems clear that the mental work of the school day does not produce any marked decrease in the ability to do further work. The data here given are somewhat influenced by certain factors, though not by practice. These factors will be fully discussed in a later report.

The multiplication, spelling and figure tests when given to about 300 children in another city showed the following results:

The multiplication test was given to 156 children early and to 154 later. When evaluated for 153 children the results show the latter to have done $86\frac{2}{3}\%$ as much work, to have made $14\frac{7}{10}\%$ more mistakes. Taking together the work of all the children tested (594, 297 early, 297 late), we find that the children who did the work late did $2\frac{9}{10}\%$ *more* work, and made exactly the same number of mistakes.

The spelling test was given to 135 early and 128 late. When evaluated for 127 children the results show the latter to have worked through $92\frac{7}{10}\%$ as many lines, to have marked $\frac{9}{10}$ of 1 % more words, and to have marked wrongly 87 % as many words. Taking together the work of all the children tested, we find that those who did the work late worked through $94\frac{9}{10}\%$ as many lines, marked $1\frac{5}{10}\%$ more words and marked wrongly $93\frac{7}{10}\%$ as many.

The figure test was given to 156 children early and to 152 late. After reducing the results of the 156 to a basis of 152 we find that those who had the tests late did 17 % *better*.

Taking together the work of all the children tested, we find that those who had the test late did almost 2% better than those who had it early.

Besides these three tests, which are of the same sort as some of those given to the first lot of children, there was given to this second lot a test with letters similar to the figure test. This test was given to 140 children early and to an equal number late. Those doing the work late did 97 % as well as those who had it early.

The factors mentioned as influencing the work of the first set of children were largely counterbalanced by factors at work in the second; one, however, should be mentioned. A certain circumstance probably lessened the work of one class (of 30) of the first lot of children during an early spelling test. So the early work in this test should probably be reckoned about 2 % higher. On the whole these additional data render more probable our previous conclusion that "the mental work of the school day does not produce any decrease in the ability to do mental work." A glance at the following table, which summarizes the more important data, shows this better perhaps than the detailed accounts already given.

Test.	No. of Scholars Tested.	Ratio of Late to Early Work.
Multiplication.	297	$102\frac{9}{10}\%$
Spelling.	273	$101\frac{5}{10}\%$
Figures.	295	102 %
Nonsense syllables.	147	98 %
Form.	145	$94\frac{6}{10}\%$
Letters.	140	99 %

Edward Thorndike.

Western Reserve University,
Cleveland, Ohio.

THE INTERNATIONAL CATALOGUE OF SCIENTIFIC LITERATURE.

PHYSICS.

The plan proposed is to issue a book catalogue once in five years, arranged according to both subjects and authors, and to issue also, from week to week, two sets of card catalogues—one according to subjects and the other according to authors. Estimates are given of the proposed cost of this; and various alternatives are proposed, such as the issuing of a book catalogue by itself, or a book catalogue and an author card catalogue. It is estimated that each arti-

cle will require four entries, on an average one according to the author, the others according to the subjects treated of in the paper.

It is proposed also to print, at the head of each of the cards or slips, distinctive symbols to indicate the science and particular sub-division of the science to which the paper refers.

There can be no doubt but that, to satisfy the needs of workers in laboratories, the plan of having a card catalogue of subjects is by far the most satisfactory. A book catalogue would be practically useless except to a student looking up references for historical reasons, and should, therefore, be kept in a general library, and not in a laboratory library. For the use of workers in laboratories the subject card catalogue would be of the greatest importance, as everyone knows who has ever kept one. It is of great use to the director of the laboratory in the saving of time and brain matter, because he no longer needs to remember all articles which have appeared, and to the student or investigator in keeping him informed of all that is going on in his particular line of work. From the standpoint, then, of Physics there can be no doubt but that it would be desirable for the International Committee to print all three catalogues, the book catalogue and the two card catalogues; and of these the card catalogues should be kept, it seems best, in the laboratory itself, or at least in such a situation as to be ready for use by all the students.

No suggestions are asked by the Committee concerning the division of the sciences or the classification proposed; and, in fact, this matter is of secondary importance. The plan is to have the assistants and the clerks in the Central Office in London make a division of the titles according to subjects and to label the cards and slips in some definite way; so that anyone, although ignorant of the subject-matter, can arrange the cards easily and quickly when they are received.

Each card in Physics is to be marked with the letter 'D,' and each subject card is to have, further, a number, such as '5410,' which signifies the particular subdivision to which the subject has reference. In this particular case the 5 would indicate the primary division, 'Light;' the 4 the subdivision, 'Polarization;' the 10 the special subject, 'Methods of Producing Polarized Radiation.'

According to this system Physics is divided into seven 'primary divisions,' so-called, namely: Bibliography and Dynamics; Heat; Mechanical and Thermal Effects of Contact and Mixture; Vibrations, Waves and Sound; Theories of the Constitution of the Ether and of Matter; Light, including Invisible Radiation; Electro-magnetism.

'Bibliography and Dynamics' is subdivided into seven sections: Bibliography of Physics; Dynamics in General; Dynamics of a Particle and Rigid Dynamics; Elasticity; Hardness, Friction and Viscosity; Dynamics of Fluids; Measurements of Dynamical Quantities.

'Heat' is divided into seven sections: Temperature and Thermometry; Calorimetry; Determination of the Mechanical Equivalent of Heat; Fundamental Laws of Thermodynamics; Thermal Conduction and Convection; Changes of Volume and of State (Experiment and Theory); Radiation.

'Mechanical and Thermal Effects of Contact or Mixture' is divided into five sections: Friction; Capillarity; Diffusion; Transpiration and Mechanical Permeability; Imbibition and Surface Condensation of Gases; Solution and Osmose.

'Vibrations, Waves and Sound' is divided into five sections: Theory and Observation of Harmonic Vibrations; Theory of Wave Motion; Sound; The Sensation of Sound; The Physical Basis of Music.

'Light, including Invisible Radiation,' is divided into six sections: Geometrical Optics and Photometry; Velocity, Wave-length, Energy, etc., of Radiation; Interference and Diffraction; Reflection and Refraction; Polarization; The Emission of Radiation, Phosphorescence, etc.

'Electro-magnetism' is divided into eight sections: Electric and Magnetic Units; Electrostatics; Magnetism; The Electric Current; Electrolysis; Electrodynamics; Electric Discharge; Terrestrial Magnetism; The Compass, Earth Currents.

These sections are divided further into 270 sub-divisions. The cards are to go to the subscribers fully labelled, the marking being done by expert assistants in London. On being received they can be filed away in suitable cases by a clerk, no expert knowledge being required. With a suitable key as to symbols any desired reference can be found quickly, and the work being done in any subject can be ascertained easily. Any system of classification, therefore, which is extensive, definite, and free from ambiguity, will be satisfactory.

In the main, the systems proposed by the Committee of the Royal Society are most satisfactory; and the labor expended in perfecting them in the different sciences, although enormous, will be fully repaid.

Unfortunately, the classification in Physics does not entirely satisfy the requirements demanded. The primary divisions are not altogether logical, nor is the classification of certain subjects; but this is comparatively immaterial.

In some cases it would undoubtedy be well still further to sub-divide a subject. For instance, the sub-divison devoted to the 'discharge in rarefied gases,' or the one devoted to the 'measurements of wave-lengths by optical and photographic methods.' In other cases this process has been carried too far. For instance, there is no particular reason why a special sub-division should be given to the 'vapor pressure near curved surfaces.'

Again, certain subjects seem to be entirely omitted, such as 'spectrum analysis;' the 'effect of different external causes on wave-lengths,' such as the Zeeman effect and the pressure effect; the 'numerical relations between the lines of any one spectrum and between the spectra of different elements;' 'Döppler's principle;' the 'laws of radiation and absorption;' 'forced vibrations and resonance;' the 'laws of steady currents as distinct from alternating currents;' 'heat effects of currents;' 'photography;' etc.

There are sections which are almost identical, such as the 'vibration of strings and rods' under 'Sound' and the 'dynamics of flexible strings' under 'Elasticity.' It is hardly an accepted fact that the Hall effect is due to changes in specific resistance, and, therefore, one would not necessarily, place it in that section. Again, in speaking of dynamics, the word center of inertia or center of mass is preferable to center of gravity. The name 'Electro-magnetism' is not a particularly happy one for the last primary division.

The only points of importance in the classification which need be criticised, however, are, I think, the omissions, the other matters being of very little importance, owing to the fact that the classification has a key, and the fact that anyone can, therefore, easily find the reference which he desires. It would increase, however, the value of the catalogue if the scheme of classification could be somewhat remodeled, and I venture to express the hope that some action of this kind may be taken before the recommendations of the committee are accepted by the countries concerned in the proposal.

There has been no plan proposed in recent years which seems to be of so great importance to the students of Physics

throughout the world as this, and it is earnestly to be desired that enough countries and enough universities and libraries will subscribe to the enterprise to make it possible for the Central Committee to publish the book and the card catalogues.

J. S. AMES.

JOHNS HOPKINS UNIVERSITY.

CHEMISTRY.

IF the object of arranging titles of books in a bibliography in certain groups or classes is to enable readers and investigators to find more readily an article on a given subject, then the *anonymous* Committee that drew up the schedule of classification for Chemistry in the Report of the Royal Society's International Catalogue Committee has made an almost total failure.

Two methods were open to the Committee appointed to devise a classification scheme for Chemistry, either to adopt an arbitrary system, in which symbols uniformly indicate definite subjects, or to adopt the dictionary plan, in which specific words are arranged alphabetically. The latter plan has, in our opinion, great and incontestable advantages over the former, but as the Committee chose to adopt the first named method the second cannot be here considered.

The provisional plan which was submitted to the delegates at the Conference of the International Catalogue Committee, held in London, October, 1898, forms Section F, of the general scheme printed in a small volume, very difficult for others than delegates to obtain. The grand divisions, with their registration symbols, are as follows:

(No number) Chemical Bibliography.
0100 Chemistry (Specific) of the Elements.
0900 Laboratory Procedure.
1000 Organic (Carbon) Chemistry (Specific).
1010 Hydrocarbons.
1100 Alcohols and Ethers.
1200 Acids.
1300 Aldehydes and Ketones.
1400 Carbohydrates; Glucosides; Resins.
1500 Amino- and Azo-Compounds.
1600 Mixed Cycloids.
1700 Organo-Metallic and allied Compounds.
1800 Alkaloids.
1900 Proteids.
2000 Coloured Compounds.
2500 Operations in Organic Chemistry.
3000 Analytical Chemistry.
3500 Theoretical and Physical Chemistry.
4000 Physiological Chemistry.

These grand divisions are sub-divided so as to provide a class and a symbol for every substance known to the chemist or awaiting discovery; at least such is the intention. Chemical Bibliography is divided into six groups, to wit:

0000 Philosophy.
0010 History.
0020 Biography.
0030 Dictionaries, collected works, monographs, and text-books.
0040 Pedagogy.
0050 Addresses, lectures, essays and theses.

Curiously, no symbol is provided for bibliographies of chemistry, a topic that must have been prominent in the minds of the persons on the Committee.

The second grand division '**0100** Chemistry of the Elements' is intended to embrace "all specifically chemical subject-matter, and such other entries as may be desirable, relating to the elements generally, excepting carbon." In this category the elements are arranged alphabetically and to each a symbol is given, thus:

0110 (Al) Aluminium.
0120 (Sb) Antimony.
0130 (A) Argon.
* * * * *
0200 (Cd) Cadmium.
0210 (Cs) Cæsium.
* * * * *
0250 (Cl) Chlorine.
0260 (Cr) Chromium.
* * * * *
0800 (Va) Vanadium.
0810 (Yt) Ytterbium.
0820 (Y) Yttrium.
0830 (Zn) Zinc.
0840 (Zr) Zirconium.

Students, and even older chemists, who find difficulty in recalling the atomic weights of common elements will scarcely welcome the proposition to give to each element another factor, though in the case of antimony this objection disappears.

This alphabetical arrangement of the elements prevents carrying out one of the prime objects of classification, namely, the grouping of related matters; thus

0270 = Cobalt, **0500** = Nickel,
0690 = Sulphur, **0710** = Tellurium.

The natural group Ba, Ca and Sr, have respectively the unrelated numbers **0150**, **0220** and **0680**. Surely the elements might have been arranged systematically, so that related bodies would have contiguous symbols.

Annexed to the table of elements are instructions for sub-dividing entries and the following paragraph: "Specific entries relating to the halogens collectively shall be arranged in Division **0250** under *Halogens*." This mixing of a word-heading with numerical symbols is a weak feature to be again noticed.

The instructions for entering titles in sub-divisions of **0100** include the following paragraph: "Entries relating to compounds, which in the Slip Catalogue bear the number and symbol of the dominant element, together with the symbol of the secondary constituent, or dominant second constituent, shall be printed in the subdivision of their second constituent." If we understand aright this rather obscure sentence, it provides for writing on slips according to one rule and for printing them in book-form according to another rule; sodium chloride would appear, therefore, under the symbol for sodium in the written slips and under chlorine in the printed volume!

A second paragraph provides that "references to hydroxides, acids and salts shall be entered under the oxide, and corresponding sulphur compounds under the sulphide."

A third paragraph reads as follows: "(*d*) In each sub-division the entries shall be arranged in such order that those relating, α, to the history or origin of the substance come first, and following these, in the order mentioned, those relating, β, to its preparation or manufacture; γ, to its structure, or of a theoretical nature; δ, to its interactions or use; ϵ, to its compounds—these five several sections being denoted by the letters α, β, γ, δ, ϵ."

Passing without comment this non-parsable English (which occurs elsewhere in the report), the scheme introduces another arbitrary feature, Greek letters for specific subjects, which is an admission that the numerical plan is found insufficient; though it need not be, provided decimals were used, a plan which does not seem to be contemplated by the Committee. The suggestion is even made that "it would be possible to carry the analysis still farther by means of symbols, such as ψ, $\varkappa$, and so forth, to indicate physical properties, crystalline form, etc." The writers of this review venture to suggest that when the Greek alphabet is exhausted the Hebrew will come in handy.

This mixture of numerical symbols with word-headings is again resorted to in division '**0930** Operations in inorganic chemistry,' where it is suggested that "entries shall be made under significant headings, such as dissolution (*sic*) and solvents, crystallization, distillation, * * * oxidation, electrolysis, furnace operations, etc., arranged alphabetically."

To organic chemistry the symbol **1000** is assigned, under which all entries shall be arranged that relate to the subject generally; substitution derivatives of the compounds included in each of the numbered divisions—especially haloid and allied derivatives—shall, as far as possible, be en-

tered under the compounds from which they are derived.

The next paragraph provides that "entries under the name of a substance may, if necessary, be sub-divided in the same way as that proposed for inorganic substances."

Hydrocarbons receive the numerical symbol **1010**, and the scheme for indicating their substitution derivatives leads to amazing propositions; the general group is divided thus:

1010 Hydrocarbons.
1020 Paraffins.
1030 Unsaturated Open-Chain Hydrocarbons.
1040 Benzenoid Hydrocarbons.
1050 Reduced Benzenoid Hydrocarbons (Terpenes, etc.).
1060 Unclassified Hydrocarbons.

"Each of these divisions shall be sub-divided (excepting **1010** and **1020**) into isologous groups, in each of which compounds shall be entered in homologous order." Then follow two new arbitrary signs for distinguishing derivatives; these are full-faced numerals, **2**, **4**, etc., used to indicate homologous series C_nH_{2n-2}, C_nH_{2n-4}, and the full-faced letter **C**, with exponents attached to indicate the number of carbon atoms in a given compound.

Applying this scheme to nitropropane ($CH_3.CH_2.CH_2.(NO_2)$) it will receive the registration symbol **1020.C$_3$.NO$_2$**; allene (C_2:C:CH_2) will be indicated by the symbol **1030.2.C$_3$**, and bromotuluene ($C_6H_5.CH_2.Br$) will be indicated by **1040.6.C$_7$.Br**.

This plan of assigning to definite chemical bodies arbitrary symbols resembling in structure well-established formulæ is most objectionable; if carried out it would prove vexatious to chemists and of no practical value to librarians.

To alcohols and ethers the symbol **1100** is assigned; to acids, **1200**; each of these groups is sub-divided exactly as are the hydrocarbons, but the symbols of the sub-divisions do not harmonize. Since paraffins = **1020**, 'ols' should have been **1120**, and acids **1220** (instead of **1110** and **1210**).

In the paragraph on acids provision is made for indicating the number of oxygen atoms, the character of the acid and the basicity by numbers, to which ol, al, on, id or cy shall be appended, according to the origin of the acid. "Thus lactic acid would be marked **1210.C$_3$O$_3$ (1.ol)**, and protocatechuic acid, **1230.8.C$_7$O$_4$ (1.2.ol)**." Here, again, we have registration symbols resembling in a general way chemical formulæ, yet they do not show the constitution nor even suggest the name of the substance.

Number **1440** is given to carbohydrates other than mono-, di- and trisaccharides and **1450** to glucosides and **1460** to resins, and it is provided that compounds belonging to these divisions shall be entered alphabetically; this is again a departure from the numerical plan. Another rule provides that "under alkaloids (**1800**) a list shall be given of vegeto-alkaloids, together with the Latin names of the plants from which they have been obtained, arranged in the alphabetical order of the plant names." Chemists not versed in botany would find this arrangement a puzzling one. Again, "alkaloids derived from plants (**1810**) and from animals (**1820**) shall be arranged alphabetically."

Division **2000** is styled 'Coloured compounds' [!], a singular misnomer for compounds used in dyeing; yet another division, **2010**, is called 'Coloured substances, not dyestuffs,' and division **2020** is named 'dyestuffs.' Provision is made for sub-dividing these categories thus: "**2010** into Hydrocarbons (coloured), Alcohols (coloured), Ketones (coloured), etc.; **2020** into Azo dyes * * * dye-stuffs of vegetable origin, unclassified dyes," arranged alphabetically in each sub-division.

The rules concerning the entries of the sub-divisions of **3000**, Analytical Chem-

istry, also lack uniformity, clearness and exactness; "division **3200** shall include all entries relating to the determination of individual elements in their compounds and in mixtures, excluding determinations of atomic weights" which belong to division **3500** (theoretical and physical chemistry). "Division **3300** shall include all entries relating to the determination of individual compounds, *e. g.*, alkaloids, carbohydrates * * * but excluding gases. If necessary gravimetric, volumetric, electrolytic, physical, etc., methods may be distinguished by letters, such as *g*, *v*, etc." "Division **3400** (Applied Analysis) shall include all entries relating to the analysis of composite materials, such as drugs, foods, soils, waters and technical products generally, arranged under appropriate significant headings."

The remaining divisions, **3500**, Theoretical and Physical Chemistry, and **4000**, Physiological Chemistry, must be passed; the specimens given are sufficiently numerous.

A study of this remarkable scheme of classification shows that the Committee failed to recognize the fact that classification and notation are two distinct things, and that a notation need have no relation to the character of the class to which the notation is given. To differentiate the houses in a city, street and number are given; '120 Grand Avenue' suffices to distinguish a given house, and it is not necessary to construct a symbol indicating the number of stories, the number of windows and the color of the paint in order to recognize the address.

Accompanying the schedule of classification is a specimem page giving illustrations of the way in which these rules should be applied; the examples bring out forcibly the absurdities of the conglomerate method proposed. The paper on Argon, by Lord Rayleigh and W. Ramsay, receives the Kabbalistic formula '**0100**.$\beta.\varphi$,' but, if we understand rightly the Committee's rules, the numerals should be **0130**, which stands for argon.

An article by J. J. Sudborough and L. L. Lloyd, on 'Stereoisomerism as affecting formation of etheral salts from unsaturated acids,' is assigned simply the number **3500**; when, however, the same paper is entered under a different title, namely: 'Etherification of stereoisomeric unsaturated acids a criterion of structure,' it has the number **1200**γ; when, on the other hand, this paper is catalogued as: 'Cinnamic and allied acids as a criterion of structure, Etherification of,' the catalogue slip must bear the symbol **1230.10.**$C_9O_2\delta$.

To a chemist the formula of cinnamic acid $C_6H_5.CH{:}CH_2.CO_2H$ has a definite meaning, and we protest against a system that introduces symbols, analogous in appearance, yet wholly misleading as respects the composition.

An examination of the schedule of classification of Chemistry proposed by the International Catalogue Committee shows that it consists of a medley of several methods. The system includes:

1. Numbers, full-face and inferiors, used for several distinct purposes.
2. Roman capitals, to denote component elements.
3. Roman lower-case, to denote kind of chemical process.
4. Italic letters in parenthesis, to denote basicity of acids.
5. Greek lower-case letters.
6. Word-headings arranged alphabetically.
7. Special provisions; exceptions to rules.

In 1772, at Ulm, was printed a thin octavo, having the title 'Medicinisch-chymisch und alchemistisches Oraculum,' which contains a key to over two thousand symbols and kabbalistic figures found in alchemical manuscripts and books; the book is curious and instructive, as well as really serviceable to antiquarian chemists. The number

of synonyms for a given substance is large; alum has twenty-six; aqua fortis, twenty-two; mercury, thirty-eight; a pound weight, eight, and cream of tartar is credited with thirty-two; the symbols have an uncouth appearance, but are hardly more fanciful than those proposed by the Committee on the International Catalogue. Should their schedule of classification prevail, a new edition of the 'Alchemical Oracle' would soon become a necessity.

H. CARRINGTON BOLTON,
WILLIAM P. CUTTER.

METEOROLOGY.

THE schedules of classification in meteorology proposed by the International Catalogue Committee of the Royal Society seem to be fairly well adapted to secure the objects sought by the International Conference on the bibliography of science. I do not understand that the Conference or the Committee has in mind any attempt at a philosophical classification of human knowledge as embodied in the publications of scientific societies. On the contrary, their object is merely to collect together in London all possible titles of scientific works, and to so arrange these that the clerks of the Royal Society may easily copy out all the titles on any given subject that may be called for by any student or investigator. For instance, under the head of 'Earth Temperature,' No. 2,100, there may be 10,000 titles and cards; these will be subdivided into a number of divisions, probably according to special aspects and according to the countries or stations. Each of these sub-divisions may have a number between 2,100 and 2,199, or, if more sub-divisions are needed, they will be between 21,000 and 21,999. Of course, the ease with which a clerk picks out the cards that belong to a given subject desired by the student depends, first, upon the minuteness of this sub-classification, and, secondly, upon the accuracy with which the content of a memoir is expressed by its own title. This latter is the *bête noir* of all classification by titles, and there is no remedy for it except that the bibliographer examine the original memoir itself, page by page. In this respect the Royal Society must depend upon the thoroughness of those who send titles to it. The Society is simply the central office, or agent, for all the other societies and men in the scientific world. Every card that is sent to it should have inscribed on it the one or more subdivisions into which it falls. If these subdivisions do not appear on the preliminary schedules of classification that have been sent out for criticism and suggestion, then they will be inserted as fast as needed.

It seems to me that the method adopted by the Conference and the Royal Society will work just as well as any other that could be suggested, and will be a great boon to science if kept up during the next century. Of course, it will require at least ten years of experience for us to begin to appreciate either its defects or advantages. Fortunately, so far as regards meteorology, the Weather Bureau has the great international bibliography, started in 1881 under my personal supervision and already partially published. The classification adopted therein by Mr. C. J. Sawyer, after consultation with all the recognized experts of Europe and America, embraces many details not specifically mentioned in the schedule of the Royal Society, and is found very convenient when once the student has become slightly familiar with it. It endeavored to attain greater elasticity by adopting a mixture of capital and small letters, Roman and Arabic numerals, in order to designate the various divisions and sub-divisions. Thus we have IB1b to designate the Aristotelian works on meteorology in general, whereas the Royal Society classification would, undoubtedly, designate

these as 0002, or, possibly, 00021. There is very little to choose between the two methods except as to the ease in writing, speaking and printing.

As to the classification or arrangement of subjects, my personal preference would be strongly in favor of a simple dictionary catalogue.

CLEVELAND ABBE.

THE STOKES JUBILEE.

ON June 1 and 2, 1899, the University of Cambridge celebrated the fiftieth anniversary of the appointment of Sir George Gabriel Stokes to the Lucasian professorship of mathematics in that institution. During the half century of his connection with Cambridge, Professor Stokes has distinguished himself by a remarkable series of investigations in the fields of hydromechanics, physical geodesy, elasticity, the undulatory theory of light, and pure mathematics. His activity has continued down to the present date, one of his most recent papers dealing with the mechanical properties of the X-rays.

The celebration of so rare an event in academic life, and the eagerness of educational and scientific institutions to render homage to so eminent a man, naturally brought together a large body of specialists in the mathematico-physical sciences. About 400 delegates and other guests were present. Nearly all of these were entertained either in the colleges or in the homes of members of the professorial staff. Thus was it made easy for the stranger within the gates of this renowned University to see much of its inner life and to enjoy in the fullest degree its charming hospitality.

The ceremonies began on the afternoon of June 1st, with the Rede Lecture, delivered in the Senate House, by Professor Cornu, on 'The wave theory of light; its influence on modern physics.' This was delivered with admirable clearness in French. In the evening following a conversazione was held in Fitzwilliam Museum, and busts of Sir George Stokes were presented to the University and to Pembroke College (that of Stokes) by Lord Kelvin.

On the morning of June 2d the delegates and guests were received in the Senate House by the Vice-Chancellor and the delegates presented the addresses sent by the various academic and scientific institutions. There were about seventy such addresses, so that it was essential to dispense with the formal reading of them in most cases. Professor Stokes responded briefly and with great modesty to these addresses, saying that they made him feel that in his long life he ought to have accomplished much more; but, he added, humorously: If I had done more I probably should not have lived to celebrate this jubilee.

On the afternoon of June 2d the address of the University of Cambridge and a gold medal were presented to Sir George Stokes; and immediately thereafter the degree of Doctor in Science, *honoris causa*, was conferred on the following distinguished men of science: Marie Alfred Cornu, professor of experimental physics in the École Polytechnique, Paris; Jean Gaston Darboux, dean of the faculty of sciences in the University of Paris; Albert Abraham Michelson, professor of experimental physics in the University of Chicago; Magnus Gustav Mittag-Leffler, professor of pure mathematics, Stockholm; Georg Herman Quincke, professor of experimental physics in the University of Heidelberg; and Woldemar Voigt, professor of mathematical physics in the University of Göttingen.

SCIENTIFIC BOOKS.

A Text-Book of Physics—Sound. By J. H. POYNTING and J. J. THOMSON. London, Charles Griffin & Co. 1899. Pp. 163.

This is the first one of five volumes in

course of preparation by the authors, the others relating to 'Properties of Matter,' 'Heat,' 'Magnetism and Electricity,' and 'Light,' respectively.

These text-books are intended "chiefly for the use of students who lay most stress on the study of the experimental part of physics, and who have not yet reached the stage at which the reading of advanced treatises on special subjects is desirable." The nature of sound and its chief characteristics are first considered in a chapter that is wholly free of mathematics. The velocity of sound in air aud other media is then discussed, the reflection and refraction of sound, frequency and pitch of notes, resonance and forced oscillations, the analysis of vibrations by Fourier's theorem, the transverse vibrations of stretched cords, longitudinal vibrations in pipes and other air cavities, vibration of rods, plates and membranes, the Trevelyan rocker, sensitive flames and musical sand. The last chapter is on the superposition of waves, with application to the physical basis of concord and discord, and on combination tones.

The distinguished authors are so well known for their original and accurate work as investigators that the critic who is in search of mistakes will find little to note, beyond a very small number of obvious typographical errors. In the descriptive parts the style is clear and the paragraphing is good. A majority of the illustrations are in the form of diagrams. In the mathematical parts the use of calculus is wholly avoided.

In judging the practical value of a text-book it is necessary to take into view a number of considerations which have no place in connection with what is intended for the advanced reader. Regard must be had also for differences of educational method in different countries. If instruction is given by lectures entirely the text-book is merely an accompaniment for private reading. But if the text book is to be a drill book, as is, perhaps, most frequently the case in America, and especially if much of its contents be mathematical, it will almost surely be unsatisfactory unless prepared by one who has had much experience, not merely in the art of presentation, but especially in that of testing the student's success in acquisition. At the outset there must be a clear understanding as to the amount of preliminary knowledge that can be reasonably assumed on the part of the student. It is a matter of common observation that a mathematical genius is rarely ever a good mathematical teacher, because he usually fails to appreciate the difficulties experienced by those who are less gifted than himself. Even when the teaching is to be not oral, but by use of the printed page, it is wonderfully easy to express mathematical truths in such form as to put them quite beyond the grasp of a fairly intelligent student.

It is not in the domain of acoustic science, but in the art of text-book adaptation that the present volume is found somewhat wanting. If the reader can be assumed to possess already a good knowledge of general physics he will find much to interest him. But if he is to obtain his introduction to acoustics through the medium of this text-book he will not proceed very far without becoming discouraged. Underived formulas are employed so frequently that the reader who does not recognize them is justified in being impatient. He takes little satisfaction in reading that an unfamiliar mathematical statement 'can be proved;' or that it 'can be shown from the equation, etc.,' which in turn 'can be reduced to' another unrecognized form. Such statements are, of course, occasionally necessary, but in a text-book their use should be reduced to a minimum. In the great majority of cases such demonstrations amount to no demonstration at all. It is readily perceived that the author has gone through the requisite mathematical work, but does not wish to cumber his page with the details that are indispensable to a clear understanding of the subject by the student.

In a mathematical text-book, whether this term be applied to pure mathematics or to a book involving the applications of mathematics, it is of the utmost importance that all paragraphs shall be numbered, that equations shall also be numbered, and that the relation between new and old topics shall be indicated by frequent cross references. Attention to such details increases the labor of composition for the author, while the neglect of them greatly

magnifies the labor which hundreds of readers are compelled to undergo. They are wholly neglected in the present volume.

There are certain topics in acoustics which require the use of calculus for satisfactory treatment, but of which the practical results are so important that these cannot be omitted in an elementary treatise. Such, for example, is the equation expressing the relation between velocity of propagation, elasticity and density. For propagation of longitudinal waves the method of deduction without higher mathematics, first brought out by Rankine thirty years ago, is well known. In the present text-book an independent method is employed in which the formula is briefly deduced by discussion of the displacement curve for a longitudinal disturbance. Laplace's correction is satisfactorily explained, but in the application to numerical examples the student is required to apply thermodynamic principles, with which certainly the elementary student cannot be assumed to be familiar, but which will, doubtless, be explained in the future volume on 'Heat.'

The chapter on 'Frequency and Pitch of Notes' is particularly good. In the discussion of musical quality and of concord and discord prominence is justly assigned to the masterly researches of Helmholtz, but very little attention is given to the work of Rudolph König. In like manner the work of Mayer in America fails to receive any mention. The discussion of singing flames will be found better than in most text-books, including an excellent exposition of Lord Rayleigh's investigation on this subject.

On the whole the book is much to be commended to those who are already acquainted with the priciples of acoustics and who wish a modern presentation of the subject by men of high standing. For a class text-book, as commonly employed in America, it will scarcely be found well adapted.

W. Le Conte Stevens.
Washington and Lee University.

Photographic Optics. By R. S. Cole, M.A. New York, D. Van Nostrand Co. 1899. Pp. 330.

The aim of this handbook, which was originally published in England by Samson Low, Marston & Co., is to give an elementary presentation of such of the problems of optics as find application in practical photography. A careful perusal of the book leaves in the reviewer's mind the impression that the emphasized word in the title should be 'optics' and not 'photographic;' that is, 'photographic' in the sense that most American amateur photographers would use the word. The book is written from the standpoint of the student of optics rather than that of the up-to-date practical photographer.

The photographer will find given in the various chapters of the book an excellent treatment of the various optical conditions encountered in using the camera, and this treatment is thorough and made as simple as the nature of the subject will admit; the author going back to first principles in all possible cases.

Perhaps the most important section is the one on lens testing, which contains an account of the tests employed at the Kew Observatory. Photographers are too apt to assign the same degree of excellence to all lenses of the same make; but the fact is that no manufacturer turns out two lenses just alike.

The photographic-lens industry is assuming such large proportions in this country that some one of our institutions ought to establish a lens-testing department which shall duplicate here the work of the Kew Observatory in England, so that when the practical photographer buys his lens he can receive with it a certificate of excellence.

We could wish that Mr. Cole had given us detailed information in regard to the construction and use of the various modern lens combinations, such as the Zeiss, Goerz and Steinheil lenses. These are points on which the ordinary amateur photographer is utterly ignorant, and even a modest amount of enlightenment would be of great benefit to him.

The author certainly dismisses too abruptly the subject of calculating the brightness of the image and timing exposures. It is not such a wholly empirical matter as is represented. Our best amateur photographers do calculate as accurately as possible the time of their exposures, and their results warrant this expendi-

ture of care and time. Still another point that should have been treated in greater detail is the use of the ortho-chromatic plate.

On such points as the last two mentioned there is a lack of practical information which will give the book less of a circulation than it should have and deserves to have on account of its many excellent qualities.

FRANK WALDO.

BOOKS RECEIVED.

Man, Past and Present. A. H. KEANE. Cambridge University Press. 1899. Pp. xii + 584.

A Short History of Free Thought; Ancient and Modern. JOHN M. ROBERTSON. London, Swan, Sonnenschein & Co., Ltd.; New York, The Macmillan Company. 1899. Pp. xii + 446.

Vital Statistics. ARTHUR NEWSHOLME. London, Swan, Sonnenschein & Co.; New York, The Macmillan Company. 1899. Pp. xii + 353.

Every-day Butterflies: A Group of Biographies. SAMUEL HUBBARD SCUDDER. Boston and New York, Houghton, Miffiin & Company. 1899. Pp. 386.

A Selected Biography of the Anthropology and Ethnology. WILLIAM Z. RIPLEY. Boston, Trustees of the Boston Public Library. 1899. Pp. 159.

Thatsachen und Auslegungen in Bezug auf Regeneration. AUGUST WEISMANN. Jena, Gustav Fischer. 1899. Pp. 31.

Traité élémentaire du méchanique chimique fondée sur le thermodynamique. P. DUHEM. Paris, Hermann. 1899. Pp. 381.

Handbook of British, Continental and Canadian Universities, with special mention of the Courses open to Women. ISABEL MADDISON. New York, The Macmillan Company. 1899. Pp. iv + 174.

SOCIETIES AND ACADEMIES.

THE SCIENCE CLUB OF THE UNIVERSITY OF WISCONSIN.

AT the meeting of the Club held on May 12th papers were read by G. C. Comstock on 'Some Recent Applications of Photography to Astronomical Discovery' and by F. H. King on 'The Flow of Liquids through Porous Media.'

Officers for the ensuing year 1899–1900 were elected as follows: President, Mr. Charles R. Van Hise; Vice-President, Mr. Edward Kremers; Secretary and Treasurer, Mr. Charles F. Burgess.

On the evening of May 6th the Club gave a dinner in the Madison Guild Hall in recognition of the election of its first President, Mr. George Cary Comstock, to the National Academy of Sciences, and the awarding of a medal to its second President, Mr. Stephen Moulton Babcock, by the Legislature of the State of Wisconsin.

MEDAL OF THE SCIENCE CLUB OF THE UNIVERSITY OF WISCONSIN.

On June 22d the first award of the Science Club Medal will be made to that member of the senior class of the University of Wisconsin who presents the best thesis giving the results of his own original investigation of a scientific

subject. Dies have been prepared by Thomas Moring, of London, from which a medal in bronze will be struck annually for this purpose.

Wm. H. Hobbs.

TORREY BOTANICAL CLUB, MARCH 29, 1899.

The first paper was by Francis E. Lloyd, on 'The Functions of the Suspensor,' and was illustrated by drawings and a series of microscopes exhibiting slides.

Mr. Lloyd described the structure of the suspensor typical of the genera *Galium*, *Asperula*, *Vaillantia*, etc., and showed that haustoria are formed which absorb food from the endosperm. The large basal cell of *Capsella* was shown also to possess a function quite similar, because, as the preparations showed, the basal cell destroys the tissue of the inner integument in its vicinity and thus becomes imbedded in it.

The second paper was by Mrs. E. G. Britton, on 'The Ferns of the Eastern United States,' illustrated by the stereopticon.

Mrs. Britton exhibited mounted specimens of all the rarer ferns of the Eastern States, many of them of her own collection, giving the range of each species. She also exhibited lantern slides made from photographs of these ferns taken as they grow. Those of the maiden-hair, hart's tongue and beech-fern were taken from the fernery in the New York Botanical Garden; five of them were views from the Catskill Mountains taken by Mr. Van Brunt; Mr. Hulst contributed one from Lake George, and Mr. Lorenz five from Willoughby Lake, Vt. Others were Adirondack views taken by Stoddard. Mrs. Britton stated that she would continue to fill in the omissions where she had not been able to obtain photographs, and hoped to complete her collection in the future. She expressed the hope that as the interest in ferns increases, the love of them would likewise grow, and that the rarer ones would not be exterminated by useless transplanting to locations where they will not survive. It was stated that thus far Rutland county, Vermont, shows the greatest number of ferns of any county in the Eastern States, having 42 species and 10 varieties. There are seldom more than 20 species in any locality, except where there is a great variety of soil and habitat, as at Jamesville, N. Y., where Professor Underwood has found 34 species. Long Island has 25 and Staten Island 23 species.

In further illustration, the Torrey Club collection of ferns and many sheets from the Columbia collection were exhibited, also a series of photographs from Professor Atkinson, showing the variations produced by cultivation of *Onoclea sensibilis*.

An exhibit to illustrate *Onoclea sensibilis* in in the fossil state was also furnished by Dr. Hollick, being of special interest as the only living species which is actually found fossil.

Mr. William A. Lawrence, of Hartford, Conn, was introduced by Dr. Rusby, as one who had collected 34 species of ferns about Willoughby Lake, Vt. Mr. Lorenz described the lake and neighboring cliffs, with the illustration of lantern slides, and spoke of the hundreds of plants of *Woodsia glabella* flourishing there close together, fruiting at one inch or at six inches. In the sunshine it becomes more leathery, as if passing into *W. hyperborea*. Mr. Lorenz also finds *Aspidium spinulosum dilatatum* reverting there to the type of the species.

Dr. Rusby and Dr. A. R. Grout also described their visits to Willoughby Lake.

Mr. W. A. Clute exhibited several fronds of *Dryopteris simulata*, collected by him at Babylon, L. I., last summer, and pointed out a distinction from *D. Thelypteris* in the fact that each pinna of *D. simulata* is not of uniform breadth but broader near the middle. It fruits chiefly in the shade, *D. Thelypteris* in the sun.

Dr. Rusby spoke of the beauty of the ferns on the mountain slopes near Plainfield, N. J., and of the localities near there for *Asplenium ebenoides*, *Cystopteris fragilis* and *Cheilanthes lanuginosa*.

Mr. Clute remarked that he had collected 16 species of ferns within a mile of Fort Lee, and 59 species are now growing at the Botanic Garden.

Edward S. Burgess,
Secretary.

ZOOLOGICAL CLUB, UNIVERSITY OF CHICAGO—MEETINGS OF WINTER AND SPRING QUARTERS, 1899.

Ovarian Structure in an Abnormal Pigeon.—The bird in question was the offspring of a

Vienna white (*Columba alba*) and a common ring dove (*Turtur risorius*). She was remarkable for her unusual appearance and manner, and upon dissection the ovary was found to be abnormal. The first thing in the structure of the ovary to strike the attention was the large number of double eggs, that is, two or more eggs lay within the common follicle; they might or might not be separated by a distinct membrane.

Most of the larger eggs were vacuolated, the vacuoles always appearing in connection with the substance of the sphere or yolk-nucleus. This sphere substance seemed to be also closely related to the membrane separating double eggs.

The nuclei in many cases were shrunken and seemed to be degenerating. Nucleoli were frequently present, but in many cases were indistinct and irregular in outline. Mitotic division of the nucleus was never observed, although one or two centrosomes were often present. Many of the eggs, especially the larger ones, were undergoing resorption by means of phagocytes which were the transformed follicle cells. Instances were found where the follicle cells had disappeared along part of the periphery of the egg, leaving behind a deposit of pigment. The doubling of the eggs seemed to be due in most of the smaller ones to division of the primordial egg cell, and in the larger ones to fusion of contiguous cells. The cause of such abnormalities is not known. Some connection with hybridization may be shown later.

MICHAEL F. GUYER.

Titles of papers given during the two Quarters: 'Life-History of *Dicyema*,' Professor W. M. Wheeler; 'Abnormalities in Ovigenesis,' M. F. Guyer; 'Recent Literature on Annelid Morphology,' R. S. Lillie; 'Experimental Production of Meroblastic Cleavage in the Frog's Egg (O. Hertwig), Dr. C. M. Child; 'Recent Experimental Work on the Ctenophore Egg' (Fischel & H. E. Zeigler), Dr. C. M. Child; 'Some Native Americans' (illustrated), A. L. Melander & C. T. Brues; 'The Formation of Giant Embryos in *Ascaris*' (Zur Strassen), H. H. Newman; 'Blind Fishes,' Professor C. H. Eigenmann, of the University of Indiana; 'Instincts and Habits of Solitary Wasps (Peckham), Miss M. M. Enteman; 'The Evolution of the Color-pattern in the Pigeon's Wing,' Professor C. O. Whitman; 'The Excretory Organs of Petromyzon,' Professor W. M. Wheeler; 'The Excretory System of Turtles,' Miss E. R. Gregory; 'A Review of the Phosphorescent Organs of Animals' (illustrated), Professor S. Watasé; 'Hybridism in Pigeons,' M. F. Guyer.

DISCUSSION AND CORRESPONDENCE.

TOTEMISM.

TO THE EDITOR OF SCIENCE: Totemism has been a most obscure subject, and it is only of late that any real light has been thrown on it by the publication of Baldwin-Gillen's 'Native Tribes of Central Australia,' which is ably discussed by Mr. J. G. Frazer in the April and May numbers of the *Fortnightly Review*. Among the Australians an Emu group, *e. g.*, is that who by refraining from killing and eating emus show that by their friendship with emus they acquire power with them, and identify themselves with the emus by blood ceremonies and by masquerading as emus. Now, all this we may interpret as a trap, a bit of animistic cunning like that of the hunter stalking. The Emu men are specialized as a group to a control over the emus by magic rites, making them multiply and be convenient food for the rest of the tribe. Totemism is a cooperation primarily for food supply; "you Grub men get grubs for me by your special kinship with grubs, and we Emu men likewise will get emus for you." The Totemic method is a sly specialization by which a tribe of men get the best of their animistic fellows—emus, grubs, rain, etc.—for their own advantage, and so the Totemic organization is not a religious, but wholly an economic, socialization.

It appears to us that this interpretation, as we have just expressed it, is sufficient, and Mr. Frazer's remark about the motive of 'inconsistency' which restrains from eating Totem, as a cannibalism, presumes too much on the logical power of the native. And cannibalism is a common thing in nature; but among men and most animals is reduced to eating one's enemies or persons of another tribe; hence when the

Totem is adopted into near kinship we merely see, in the not-killing and eating, that which follows naturally the rule of human kinship. But if the main motive in abstaining from eating Totem 'is to conciliate,' then Totemism is so far religious as a method of dealing with superiors, for in a broad sense religion includes all acts toward the superior as such. But Totemism, so far as it makes the native coercive to his fellow animals by force of cunning magic, certainly is unreligious.

As to Exogamy, while this may arise similarly with abstinence from killing and eating, and is thus a saving from supposed incest, as Mr. Frazer says, we would also see that marriage within a Totem group might have the undesirable result of a Totem animal as offspring instead of a human child. Mr. Frazer reports something analogous in his book on Totemism (page 16): "Bakalai think that if a man were to eat his Totem the women of his clan would miscarry and give birth to animals of the Totem kind or die with an awful disease."

It would be of interest to know whether there is a Totemic instinct and whether it emerges in civilized children. I think it might be found, especially among street Arabs and others early thrown on their own resources. As to Totemism bearing on the domestication of animals, the researches of McGee and others in the United States favor domestication of animals from commensalism. (Cf. also domestication of snakes as ratters in the Philippines.) Totemism certainly acts analogously to a limited close period by restricting those who shall kill and eat certain food animals; but the Totemic idea of controlling by spell is contrary to the idea of direct subjection, and would scarcely lead to it. The Totem group are merely those who stay at home, and by their intimate relationship weave the spells by which the prey is made plenteous and convenient to the hunter.

In Totemism and also Fetichism—which is but a means to Totemic power—we see the first groping of the human mind toward causal relation and its practical application; but so grossly animistic, especially in its kinship idea, as to be difficult of understanding by civilized man with his scientific mode of thought. The Totemic control of nature by making oneself akin, is antipodal to the depersonalizing scientific method. Totemism is the human animal fascinating his prey by kinship rite and spell.

Hiram M. Stanley.

Lake Forest, Ill., May 29, 1899.

Arousal of an Instinct by Taste Only.

Editor of Science: The following observation is submitted on the chance that it may be of use. A dead mouse was given to two kittens eight weeks old. They showed no interest in it from sight or smell, but as soon as they were made to taste the mouse they went into a fighting passion, which remained as long as the mouse was tasted. When they were forced to give up the mouse, all interest was lost and could not be aroused even by smell. Yet as soon as the tongue again touched the mouse the kitten fell into the same passion of fighting. One test showed marked results. Giving the mouse to one kitten, I held it, scratching vigorously, in one hand, while with the other hand I made the other kitten touch and smell the mouse and finally taste it. As long as the second one did not taste the mouse it showed no interest, but it began to fight vigorously at the moment of tasting. As soon as the first kitten was made to release its hold on the mouse it at once ceased to show any interest.

E. W. Scripture.

Current Notes on Meteorology.

Influence of the Great Lakes on Precipitation.

The *Meteorological Chart of the Great Lakes* for June (U. S. Weather Bureau) presents a chart of the normal annual precipitation of rain and snow in the drainage basins of the Great Lakes, with a set of tables and a brief summary prepared by A. J. Henry. The conclusion reached as to the influence of the Lakes on precipitation is as follows: With the possible exception of Lake Superior, the lakes do not seem to have a very marked influence on the precipitation over adjacent land areas. There is more precipitation on the south than on the north side of Lakes Superior, Erie and Ontario, the differ-

ence in the case of Lake Superior being about eight inches, while the average precipitation on the south shores of Lakes Erie and Ontario is about three inches greater than that on the north shores. The eastern shores of Lakes Michigan and Huron have a greater precipitation than the western, but the differences are not so strongly marked as between the northern and southern shores of the other lakes. The annual precipitation is somewhat less over the northern peninsula of Michigan as compared with the immediate shore line, and the precipitation over the interior of the northern portion of the lower peninsula is considerably less than on the shores of the lakes on either side.

REPORT OF THE CHIEF OF THE WEATHER BUREAU.

THE *Report of the Chief of the Weather Bureau for 1897–98* is an unusually interesting volume. We note that Section I., which deals with *New Work and Special Investigations*, includes an account of the kite work, illustrated by reproductions of a considerable number of kite meteorograph curves. Deaths by lightning during the year 1897 are reported as reaching 362, which is the largest number in any single year since a record has been kept. The number of deaths due to violent storms was 55. Part VII. contains *The Climate of Cuba*, by W. F. R. Phillips, a somewhat fuller account than that published in Bulletin No. 22 (see SCIENCE, July 1, 1898, p. 16); *Temperature, Rainfall and Humidity at San Juan, Porto Rico*, and *The Weather of Manila*, both by W. F. R. Phillips. The latter account was contained in Bulletin No. 22. Two papers by Professor H. A. Hazen, one on *Meteorologic Waves* and one on *The Distribution of Moisture in the United States*, both well illustrated, close the volume.

JAMAICA WEATHER SERVICE.

OWING to the withdrawal, by the government, of the annual subsidy, the Jamaica Weather Service came to an end on April 1st of this year. This service was established in 1880, and has done valuable work in furnishing warnings of coming hurricanes, as well as in carrying on and publishing investigations of hurricanes, rainfall, damage by lightning, etc. Mr. Maxwell Hall has been in charge of the Jamaica Weather Service from the start, and has had the able assistance of Mr. Robert Johnstone, as observer in charge at Kingston. The announcement is now made that Mr. Johnstone's services must be dispensed with, and that the first-class station at Kingston and the second-class station at Montego Bay must be discontinued.

NEW DAILY WEATHER MAPS.

THE *Monthly Weather Review* for March notes the issue of two new daily weather maps, one in Canada and the other in Mexico. In the summer of 1898 the Canadian Meteorological Service established a Pacific Coast Division with headquarters at Victoria, B. C. An interchange of daily telegraphic reports takes place between our own Weather Bureau and that of Canada, so that the information available to one is also accessible to the other. It is expected that daily maps and forecasts will be issued by the Pacific Coast Division of the Canadian Weather Service similar to those now issued by the U. S. Weather Bureau at San Francisco and at Portland, Ore. On March 1, 1899, the Republic of Mexico began the publication of a daily weather map, 12 by 16 inches in size, the observations being made at 8 a. m., 75th meridian time. The map makes possible an immediate connection with the daily maps of the United States and of Canada.

WINTER TEMPERATURES AT DAWSON CITY.

THE *Monthly Weather Review* for March also contains a summary of some meteorological observations made at Dawson City during November and December, 1898, and January, 1899, by U. G. Myers, Observer, Weather Bureau. The maximum in November was 23.3°; the minimum, –41.4°. In December the maximum was 38.0° and the minimum —41.0°. In January the maximum and minimum were 2.0° and —45.0°, respectively.

RECENT PUBLICATIONS.

The Use of Kites in the Exploration of the Upper Air. C. F. MARVIN, Professor of Meteorology, U. S. Weather Bureau. Year-book of

the Department of Agriculture for 1898. Pp. 201–212. Pls. I. Figs. 9.

Description of the standard Weather Bureau kite and apparatus, with illustrations.

Proceedings of the Convention of Weather Bureau Officials held at Omaha, Nebraska, October 13–14, 1898. Prepared under the direction of Willis L. Moore, Chief of Weather Bureau. U. S. Department of Agriculture, Weather Bureau. Bulletin No. 24. 8vo. Washington, D. C., 1899. Pp. 184.

This Bulletin contains a large number of papers on a wide range of subjects connected with the work of the Weather Bureau and with the relations of the Bureau to the public.

R. DeC. Ward.

Harvard University.

BOTANICAL NOTES.

THE VARIETIES OF CORN.

Several years ago the lamented Dr. Sturtevant published privately the results of his studies of Indian Corn, with especial reference to the varieties which have been created by man since he has had it under cultivation. The value of the original paper was such that the Department of Agriculture has done wisely in determining to bring out this considerably enlarged and improved edition as one of the publications of the Office of Experiment Stations (Bulletin No. 57). It is an attempt to treat in a scientific manner the whole problem of the varieties into which the originally single species has developed under man's selection. It is thus a contribution to our knowledge of the evolution of a species under cultivation.

The paper opens with a technical description of the Family *Gramineae*, the tribe *Maydeae* and the genus *Zea*, and then follow descriptions of 'the one recognized species,' *Zea mays* L., and the 'species groups.' In discussing the variations in the species the author says: "The species *Zea mays* includes exceedingly divergent forms. The height of the plant in varieties and localities has been reported from 18 inches for the Golden Tom Thumb pop to 30 feet or more for varieties in the West Indies, and single stalks in Tennessee at 22½ feet. I have seen ears 1 inch long in the pop class and 16 inches long in the dent class. The rows in varieties may vary from 8 to 24 or more, and in individual ears are reported from 4 to 48. A hundred kernels of Miniature pop weighed 46 grains, of Cuzco soft 1,531 grains. In some varieties the ears are long and slender; in others, short and thick; in the Bear Foot pop, flat. Some varieties have flat kernels; other varieties have spheroidal kernels; yet others, conical kernels. The summits of the kernels may be flat, rounded, pointed or indented. These kernels, usually upright on the cob, may be sloping or imbricated, firm or loose, usually sessile, yet sometimes stalked. In structure some are corneous throughout; others are partly corneous and partly farinaceous, others entirely farinaceous. * * * The season also varies. A variety that ripens in one month is mentioned from Paraguay, and seven months are said to be required in some southern countries. * * * In one group of corn each kernel is surrounded by a husk and the ear thus formed is itself enveloped in husks. In all our field and garden corns, however, the seed is naked on the cob."

With all these variations before him the author finds little difficulty in dividing the 'polymorphic species *Zea mays*' into a number of groups, "which, on account of their well-defined and persistent characters, may be considered as presenting specific nomenclature." Accordingly, the author proposes six 'species groups,' each having the value of species in process of formation (if we understand the author aright). These species of a lower order are as follows:

1. *Zea tunicata*, the pod corns, in which each kernel is enclosed in a pod or husks. This is thought by some to be the type of the primitive maize, but Dr. Sturtevant very shrewdly suggests that "a more complete study, with more ample material, may possibly bring this group under the classification of abnormalities, the pod being but a proliferous condition."

2. *Zea everta*, the pop corns, in which the excessive proportion of corneous endosperm and the small size of the kernels and ears are characteristic. Twenty-five varieties are recognized.

3. *Zea indurata*, the flint corns, in which the corneous endosperm encloses a mass of starchy endosperm, the summit of the kernel being in all cases covered by the corneous layer. Sixty-nine varieties are recognized, among which the common 'Eight-rowed corn of New England' is a familiar example.

4. *Zea indentata*, the dent corns, in which the corneous endosperm occurs at the sides only of the kernel, the starchy endosperm extending to the summit. By the drying and shrinkage of the starchy matter the summit of the kernel becomes indented, whence the name 'dent' corn. No less than 323 varieties are recognized as belonging to this 'species group,' of which the common corn of the Central States, North and South, furnishes many examples.

5. *Zea amylacea*, the soft corns, characterized by the absence of corneous endosperm. Twenty-seven varieties are recognized. Tuscarora, Cuzco and Zuni are examples. "The mummy corns, from Peru and Chili, that I have examined have been soft corns in four varieties."

6. *Zea Zaccarata*, the sweet corns, characterized by the translucent, horny appearance of the kernels, and their more or less crinkled, wrinkled or shriveled condition. Sixty-three varieties are recognized.

While we may not be willing to accept these 'species groups' as species in the ordinary sense, it is fair to say that, in our opinion, they are as much entitled to specific rank as many of those which have been described recently. If the systematic botanists ever turn to such plants as Maize, Wheat, etc., we may expect not only the acceptance of the forms indicated above as good species, but also the addition of many more.

THE AGRICULTURAL GRASSES OF KANSAS.

A RECENT Experiment Station Bulletin (No. 87) issued by the Kansas Station contains some matter of more than usual interest to botanists. It deals with the grasses of importance to agriculture, and on that account might be supposed to contain little, if anything, of value to the scientific botanist, but it requires only an examination of this bulletin to show that one cannot judge of the value of a paper by the title. Professor Hitchcock has made a paper of much interest to the botanist, and we dare say that it is not one whit less useful to the farmers for whom, primarily, it was written. Twenty-six species of wild grasses are mentioned, and, by means of illustrations and popular descriptions, their identity will not be difficult for the farmer and stockman. To the botanist the neat little maps which show the distribution of the species are full of interest, as are also the paragraphs which indicate, popularly, it is true, the main phytogeographic features of the State. The latter are as follows: Wooded regions; sloughs, swales and wet meadows; bottom lands; prairies of eastern Kansas; sandy regions; stony hills; salt plains and alkali spots. One cannot but regret that the text is disfigured by the spelling 'thru' and 'thruout,' but we surmise that this is not to be laid at the door of the writer of the Bulletin.

DISEASES OF THE SWEET POTATO.

THAT delicious vegetable, the sweet potato, is affected most grievously by diseases which must make life a burden to the grower, whatever they may do to the unfortunate plants themselves. In a recent bulletin issued by the Maryland Experiment Station, Dr. C. O. Townsend described eight diseases of the sweet potato. These are known under the following names: Black Rot, Soil Rot, Soft Rot, Stem Rot, White Rot, Dry Rot, Scurf, Leaf Mould. In every case the disease is produced by a fungous parasite which attacks the tissues. Thus Black Rot is caused by *Ceratocystis fimbriata;* Soil Rot by *Acrocystis batatas;* Soft Rot by the ubiquitous 'black mould' *Rhizopus nigricans;* Stem Rot by *Nectria ipomœæ;* White Rot by some *Penicillium;* Dry Rot by *Phoma batatæ;* Scurf by *Monilochætes infuscans;* Leaf Mould by *Albugo* (*Cystopus*) *ipomœæ-panduranæ.* Nine years ago Dr. Halsted, of the New Jersey Experiment Station, published a similar paper (Bulletin 76) in which he described still another disease of this sorely afflicted plant, viz., Leaf Blight caused by *Phyllosticta bataticola*, making nine diseases in all. The remedies to be employed by the growers include the following: Discard all diseased sets; spray with Bordeaux mixture; rotate crops; treat the soil with sul-

phur, four hundred pounds to the acre; gather and burn all diseased roots at the time the crop is harvested; destroy all related weeds, avoid bruising the tubers; store in dry places at a temperature of about 70°; remove and burn diseased tubers as soon as they begin to decay. Surely the grower of the sweet potato must be alert to bring his crop to a successful issue.

CHARLES E. BESSEY.

UNIVERSITY OF NEBRASKA.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE preliminary announcement of the forty-eighth meeting of the American Association for the Advancement of Science has been issued by the local committee. It will be remembered that the meeting will be held at Columbus, Ohio, from the 21st to the 26th of August, under the presidency of Professor Edward Orton. The first general session will as usual be held on Monday morning, when the President elect will be introduced by the retiring President, Professor F. W. Putnam, and addresses of welcome will be made by the Governor of Ohio and the Mayor of Columbus. The addresses of the Vice-Presidents will be given on Monday afternoon, and the address of the retiring President in the evening. The several sections will meet as usual during the week, and Saturday will be devoted to an excursion, probably to the mounds at Fort Ancient, the coal mines in Hocking Valley and the natural-gas fields. Further information may be obtained from the Permanent Secretary of the Association, Dr. L. O. Howard, Cosmos Club, Washington, D. C., and from the Local Secretary, Professor B. F. Thomas, Ohio State University.

The societies meeting in affiliation with the Association are as follows:

The American Forestry Association will meet on Tuesday and Wednesday, August 22d and 23d, in Horticultural Hall. Hon. James Wilson, Washington, D. C., President; G. P. Whittlesey, Washington, D. C., Secretary.

The Geological Society of America will meet on Tuesday, August 22d, at the same time and place with Section E. B. K. Emerson, Amherst, Mass., President; H. L. Fairchild, Rochester, N. Y., Secretary.

The American Chemical Society will hold a general meeting on Monday and Tuesday, August 21st and 22d, and the remainder of the week will be given to Section C. Edward W. Morley, Cleveland, Ohio, President; Albert C. Hale, 551 Putnam Avenue, Brooklyn, N. Y., Secretary.

The Society for the Promotion of Agricultural Science will meet on Friday and Saturday, August 18th and 19th. B. D. Halsted, New Brunswick, N. J., President; C. S. Plumb, Lafayette, Ind., Secretary.

The Association of Economic Entomologists will hold its eleventh annual meeting on August 18th and 19th. C. L. Marlatt, Washington, D. C., President; A. H. Kirkland, Malden, Mass., Secretary.

The American Mathematical Society will meet on Friday and Saturday, August 25th and 26th. R. S. Woodward, Columbia University, New York, President; F. N. Cole, Columbia University, New York, Secretary.

The Society for the Promotion of Engineering Education will hold its meeting on August 17th, 18th and 19th. Albert Kingsbury, Durham, N. H., Secretary.

The American Folk-Lore Society will probably meet with Section H on Thursday, August 24th. W. W. Newell, Cambridge, Mass., Secretary.

The Botanical Society of America will meet on Friday and Saturday, August 18th and 19th. On Friday, at 4 p. m., business meeting; 8 p. m., address of retiring President; on Saturday, 9 a. m., business meeting; 9:30 a. m., and 2 p. m., sessions for reading papers. G. F. Atkinson, Ithaca, N. Y., Secretary.

The American Microscopical Society will meet August 16th, 17th and 18th. Henry B. Ward, Lincoln, Neb., Secretary.

THE CENTENARY OF THE ROYAL INSTITUTION.

THE celebration of the centenary of the foundation of the Royal Institution, London, took place in accordance with the plans we have already announced. Commemorative addresses were made by Lord Rayleigh and Professor Dewar, and at the banquet on June 5th

the Prince of Wales, the Duke of Cambridge and Professor Langley, of the Smithsonian Institution, made speeches.

As part of the celebration there was an exhibition of historical apparatus, regarding which we take the following from the London *Times*: Most of it belongs to the Institution's own collection, but a considerable number of articles are on loan, some memorials of Davy having been sent by Dr. Humphry Davy Rolleston, his grand-nephew, and some of Faraday by his niece, Miss Jane Barnard, and other members of the Barnard family. The founder, Count Rumford, is represented by some models—a grate, fireplace, chimneys, roaster and stewpan, which may be taken as typical of the purposes which he conceived the Institution should serve. Of the first professor, Dr. Garnett, nothing seems to remain but his picture, and the objects that belonged to the second, Dr. Thomas Young, are not very numerous or striking.

Of Sir Humphry Davy, however, the relics are most interesting, for they carry the mind back to what are probably his two best-known achievements. In the first place there is a couple of the batteries or galvanic troughs with which he was able to effect the decomposition of the alkalis, and in the second a large collection of the lamps with which he experimented in the effort—finally, of course, successful—to find a form safe for use in dangerous coal mines. Other memorials of Davy include a portrait of him in court dress occupying the presidential chair of the Royal Society, the three medals he received at various times from that body, the Napoleon medal for the 'best experiment on the galvanic fluid' awarded him in 1807 by the French Institute, whose action raised a storm of indignation, because England and France were then at war, and many specimens of his correspondence, not the least interesting being some of the love letters he addressed to the charming Mrs. Apreece, his marriage with whom in 1812 terminated his connection with the Institution.

The articles associated with Faraday are still more numerous. There is the original apparatus with which he obtained the magneto-electric spark; the big electro-magnet with a copper disc spinning between its poles, which formed the first machine for continuously generating an electric current by means of magnetism, and which is, therefore, the direct ancestor of the modern dynamo; early forms of galvanometers and electrical-influence machines; a series of delicate glass vessels filled with various gases, which he used in his determinations of magnetic and diamagnetic properties, together with the 'diamagnetic box' he presented to Tyndall; the apparatus employed in the first experiments on the liquefaction of gases, with some of the tubes filled by himself; many specimens of the heavy glass in which he did such memorable work; and a curious bit of apparatus, consisting apparently of a block of this glass, surrounded with a coil of fine wire, which he doubtless used in one of his numerous experiments to discover a connection between light and magnetism. The way in which the last is put together shows plainly the influence of the apprenticeship to a bookbinder which Faraday served in his early life, and another beautifully neat example of his expertness in this craft may be seen in a bound manuscript volume of Davy's lectures 'taken off from notes by M. Faraday,' which is particularly interesting as having led to his engagement as an assistant in the institution's laboratory.

Among the apparatus belonging to men more recently connected with the Royal Institution may be mentioned that used by Tyndall in his investigations on radiant heat and on germ life, the electrical instruments of Dr. Warren de la Rue, and last, but not least, the magnificent collection of physical apparatus that was the property of the late Mr. William Spottiswoode, successively Treasurer and Secretary of the Institution. This includes a splendid series of Nicol's prisms and other apparatus for experimenting in the polarization of light, a huge electro-magnet made by Ducretet, of Paris, and the famous induction coil containing 280 miles of wire in its secondary circuit and capable of giving a spark 3½ feet long. The whole has just been presented to the Institution by Mr. W. Hugh Spottiswoode, and it will form a most worthy memorial of the year in which that society completes its century of useful and honorable existence.

SCIENTIFIC NOTES AND NEWS.

SECRETARY LONG, of the Navy Department, has appointed a Board of Visitors to examine and report upon the U. S. Naval Observatory, to consist of Senator Wm. E. Chandler; Representative Alston G. Dayton; Professor Geo. C. Comstock, Director of the Observatory of the University of Wisconsin, Madison, Wis.; Professor Geo. E. Hale, Director of the Yerkes Observatory, Williams Bay, Wis.; and Professor Edward C. Pickering, Director of the Harvard College Observatory, Cambridge, Mass. This Board of Visitors will meet at the Naval Observatory on the 30th of the month.

WE learn from Dr. Tiessen, of Berlin, that the Norwegian Storthing has passed an act regulating the administration of the Nobel foundation. The prizes, which it will be remembered are in physics, chemistry, medicine, literature and for the promotion of peace, will each be of the value of 15,000 crowns (about $11,000) annually. The prizes are to be conferred on the anniversary of Nobel's death, on the 18th of December, and for the first time in 1901. The prizes in physics and chemistry are to be awarded by the Swedish Academy of Sciences and the prize in medicine or physiology by the Medico-Surgical Institute of Stockholm. Any one making application for one of the prizes is thereby excluded. A prize may be divided between two persons who have carried out a joint work. It appears that part of the income is to be used for the establishment of Nobel Institutes, regarding the scope of which we are not informed.

SEVERAL years ago Dr. Robert Lamborn bequeathed to the Philadelphia Academy of Natural Sciences his entire estate, valued at over $600,000. The will was contested and a compromise has now been effected by which half of the property is received by the Academy.

THE American Geographical Society, New York, has bought a plot of land 50 x 102 feet on the north side of West 82d St., near Central Park, and facing the open square on which stands the American Museum of Natural History. In addition to the legacy of General Cullum, subscriptions amounting to $30,400 have been received, and the Council proposes to begin the construction of a fire-proof building, completing it at present only so far as may be necessary to provide for a library and offices.

ON the occasion of the official inspection of the Royal Observatory, Greenwich, on June 3d, the new buildings were opened to visitors. The new Observatory building, which has been in progress since 1891, was completed last March by the addition of the east and west wings, and a new magnetic pavilion, in an enclosure in Greenwich Park, about 360 yards from the Observatory, was completed last September. Among the distinguished visitors present were M. Cornu and Professor Newcomb.

THE University of Oxford, on June 8th, entertained the delegates to the centenary of the Royal Institution and conferred the honorary D.C.L. upon the following: Henri Becquerel, Membre de l'Institut, professor of physics at the École Polytechnique, Paris; Guglielmo Körner, professor of chemistry in the Scuola Superiore d'Agricultura, Milan; Matthias Eugen Oscar Liebreich, Director of the Pharmacological Laboratory, and professor of pharmacology in the University of Berlin; Henri Moissan, professor of toxicology in the École Supérieure de Pharmacie, Paris, and Simon Newcomb, U. S. Navy and Johns Hopkins University. At the luncheon, given in the hall of Christ Church, Professor Newcomb responded to the toast in honor of the guests.

THE following have been elected foreign members of the Royal Society: Dr. Ludwig Boltzmann, professor of theoretical physics in the University of Vienna; Dr. Neumayer, of the Hamburg Observatory; Dr. Anton Dohrn, Director of the Zoological Station, Naples; Professor Emil Fischer, professor of chemistry at the University of Berlin, and Dr. Melchior Treub, Director of the Buitenzorg Botanical Gardens.

ERNST A. BESSEY, A.M., of the University of Nebraska, has been appointed to the position of Assistant Vegetable Pathologist in the Division of Vegetable Physiology and Pathology in the United States Department of Agriculture, the appointment dating from June 1st.

THE subjects of Professor Emile Picard's lectures to be delivered at Clark University, in

connection with the Decennial Celebration, July 5th to 8th, are as follows: (1) Sur le développement des mathématiques, et en particulier de l'idée de fonction, depuis un siècle. (2) Quelques vues générales sur la théorie des équations différentielles. (3) Sur la théorie générale des fonctions analytiques et sur quelques fonctions spéciales.

THE statue of Benjamin Franklin, presented to the city of Philadelphia by Mr. Justus C. Strawbridge, was unveiled on June 14th with ceremonies under the auspices of the University of Pennsylvania, the American Philosophical Society, the Franklin Institute, the Library Company of Philadelphia, and the Pennsylvania Hospital. The oration was delivered by U. S. District Attorney James M. Beck.

THE death is announced of Dr. A. Charpentier, professor in the faculty of medicine in the University of Paris, and the author of contributions on vision numbering over 100. His publications concern especially the time phenomena of vision, intensity, contrast, etc.

DR. LAWSON TAIT, a surgeon of Birmingham, England, who was eminent for his operations in abdominal surgery, died in London on June 13th, aged fifty-five years.

THE next meeting of the International Committee on Meteorology has been called for August 25th of the present year at St. Petersburg.

THE annual meeting of the Royal Geographical Society, London, was held on June 5th, when the medals were awarded in accordance with the announcement that we have already made. A banquet was held in the evening. Among the speakers were Count du Pontavice de Heussey, who had received one of the medals in the afternoon, and the American Ambassador, Mr. Choate.

THE 21st Congress of French Geographical Societies will be held at the building of the Paris Society of Geography, from the 23d to the 29th of July, 1900.

DR. CYRUS ADLER informs us that Comte Angelo De Gubernatis, President of the 12th International Congress of Orientalists, to meet at Rome, October 12, 1899, states that a special section of this Congress will be devoted to researches concerning the origin of the American Indians, and that papers from students of American archæology, ethnography, mythology and folklore will be welcome.

A REUTER telegram from Stockholm, dated June 6th, says that the Anthropological and Geographical Society of Stockholm has received the following telegram from Herr Vathne, a shipowner at Mandal: "Captain Hueland, of the steamship *Vaagen*, who arrived there on Monday morning, reports that when at Kola Fjord, Iceland, in 65° 34′ north lat., 21° 28′ west long., on May 14th, he found a drifting buoy marked 'No. 7.' Inside the buoy was a capsule, marked 'Andrée's Polar Expedition,' containing a slip of paper, on which was written the following: 'Drifting buoy, No. 7. This buoy was thrown out from Andrée's balloon on July 11, 1897, 10:55 p. m., Greenwich mean time, 82° north lat., 25° east long. We are at an altitude of 600 metres; all well. Andrée, Strindberg, Fraenckel.'" Herr Andrée made his ascent from Danes Island on July 11, 1897, at 3 o'clock in the afternoon, so that when the buoy was thrown out the explorer had only travelled seven hours and 55 minutes.

THE *Stella Polare*, with the Duke of Abruzzi, nephew of the King of Italy, and his polar expedition on board, sailed from Christiania on June 12th.

AMONG those who will embark on the steamship *Hope* for the Arctic regions are Professor Wm. Libbey, of Princeton University, and Dr. Robert Stein, of the U. S. Coast and Geodetic Survey. Dr. Stein will spend the winter in Ellesmereland, and will be accompanied by Dr. Leopold Kann, who will pay special attention to the study of terrestrial magnetism.

THE New Mexico Biological Station will be conducted this summer at Las Vegas, N. M., beginning work about June 25th. Mr. T. D. A. Cockerell will be in charge, and will be assisted by Miss W. Porter. It is also expected that two parties will undertake field-investigations in New Mexico, Professor C. L. Herrick having charge of a geological party, and Professor E. L. Hewitt of an anthropological one. Professor E. O. Wooton will also be

in the field, investigating the flora of the White Mountain region of New Mexico, which has already yielded him so many interesting novelties. Professor C. H. T. Townsend and Mr. C. M. Barber are collecting in the region of the Sierra Madre Mountains, in northern Mexico.

Professor W. A. Setchell, of the University of California, and other botanists of the University, are about to leave on an expedition to study the flora of the Aleutian Islands.

Two French explorers have returned to Paris, Dr. Maclaud, who had been in French Guinea, and M. Peroy, who has been for three years in Gen-Thé and Caï-Binh.

Mr. Charles H. Senff has given $5,000 to the zoological department of Columbia University for purposes of exploration and publication. Mr. Harrington and Mr. Sumner expect, with the assistance of this fund, to make a second expedition to the Nile in search of *Polypterus*, if the unsettled political conditions make this possible. The fund will also be used for the publication of a memoir on the anatomy of *Polypterus*, to be undertaken conjointly by Messrs. Dean, Harrington, McGregor, Strong, Herrick and Professor Wheeler, of the University of Chicago. Professor E. B. Wilson, after ascertaining last spring that the trip to Khartoum was impracticable, established a temporary laboratory at Mansourah, upon the lower Nile, the point visited by Messrs. Harrington and Hunt last summer. The fishermen assured him that *Polypterus* would return in quantity, and raised his hopes greatly; but, when after a long period, the fish began to appear it was ascertained that all the females had spawned, so that further efforts to obtain the eggs would be futile during the remainder of the season. Professor Wilson is now occupying the Columbia University table at Naples and is engaged in the revision for the third edition of his volume, 'The Cell,' which is to be translated into Italian and French.

The Peabody Museum, of Harvard University, has received from the heirs of the late Moses D. Kimball a valuable collection of archæological and ethnological specimens.

At a meeting of the British Astronomical Association on May 31st Mr. E. Walter Maunder announced that the report of the eclipse expeditions of last year were now far advanced and were expected to be issued before the next meeting. With regard to the arrangements of the expeditions for next year, they had not yet entered into a contract with any steamship company, but they were carrying on negotiations in that direction. They expected to arrange without difficulty for a steamship to take a party out from England, leaving approximately a fortnight before the eclipse, and reaching England again about a week after it. It would probably call at some port in Portugal—either Oporto or Lisbon—then, perhaps, at Cadiz and Alicante, finally going to Algiers, where the steamer could be used as a hotel by those members of the party who went the full journey. They had received 109 names so far for the European and Algerian expedition, and additions to that number were expected.

The University of the State of New York has just issued a museum bulletin by the State Entomologist, Dr. Felt, on *Shade Tree Pests*. Those likely to prove most destructive this season are described and depicted in various stages, and directions for the most effective means of exterminating them are given. This bulletin, No. 27, will be sent to any address for five cents. State Paleontologist Dr. John M. Clarke has prepared a *Guide to excursions in the fossiliferous rocks of New York* (University Hand-book 15), which will be of special interest to teachers and students wishing to acquaint themselves more intimately with the classic rocks of this State. Itineraries of 32 trips are given, covering nearly the entire series of paleozoic rocks, with careful details as to typical localities, how to get to them without loss of time and comfort, what strata and fossils to look for and where to find them. It is hoped to send this hand-book to all the schools in the University before the end of the school year.

Among important American scientific books announced for early publication are the 'Races of Europe,' by Professor W. Z. Ripley (Appletons) based on the series of articles published in the *Popular Science Monthly;* and 'Statistical Methods with Special Reference to Biological Variation,' by Dr. C. B. Davenport (Wiley), de-

scribing the statistical methods elaborated by Galton and Pearson and their application in the natural sciences.

ACCORDING to the Boston *Transcript* the University of Chicago has set aside $5,000 to defray the expenses of explorations which are about to be conducted under its auspices in Yucatan. A collection of hitherto-unknown ruins has been discovered lately some distance southeast of the city of Merida, on the north coast, and a representative of the institution paid a visit to the spot this winter. He found the remains of what seemed to be an enormous tribal dwelling, with buildings scattered around it over an area of nearly a mile. The main edifice was built massively of stone, and the façades were literally covered with the most intricate and beautiful carving. The top is covered with earth and vegetation, and from a distance looks like a square wooded hill, so there is fairly good reason for supposing that the interior rooms are in a state of good preservation, at least that they have not been opened and ransacked by prowling Indians. There are many tombs also that have every appearance of being intact, and, if so, they may contain much matter to shed light on one of the most mysterious pages of the history of humanity. The exploring expedition will start some time within the next month, and New Orleans will be the point of departure.

A *conversazione* in connection with the meeting of the Institution of Civil Engineers, London, was given on August 9th, the guests being received by the President, Sir W. H. Preece. The London *Times* states that Sir W. Martin Conway showed a series of photographs taken during his recent expedition to the Andes, and Mr. Mansergh exhibited views in the Elan valley, illustrating the progress of the works, of which he is the engineer, for giving Birmingham a new supply of water from Wales. For those who desired still lighter amusement a number of electrophones were fitted up in connection with the theatres. Of engineering models and scientific apparatus there was a very interesting display. Among the former, which were particularly numerous, were representations of the *Powerful*, *Latona* and *Fearless*, lent by Messrs. Vickers, Sons & Maxim; of the *Turbinia* and a torpedo-boat destroyer with a guaranteed speed of 35 knots, from the Hon. Charles A. Parsons; of the steel ice-breaking steamer *Ermak*, from Messrs. Armstrong, Whitworth & Co.; of the proposed new bridge at Kew, from Sir John Wolfe Barry; of the new high-level bridge at Newcastle, from Mr. Charles Harrison; of the new P. and O. steamer *Isis*, from Sir Thomas Sutherland; and of dredgers of various descriptions, from Messrs. J. C. Coode and William Matthews. The Royal Ordinance Factories had an interesting exhibit showing the component parts of a 303 Lee-Enfield magazine rifle and the stages in the manufacture of a solid-drawn 6-inch cartridge case. The Cambridge Scientific Instrument Company showed some specimens of Professor Callendar's beautiful electrical recording instruments. One was arranged as a pyrometer recording the variations in the radiation from an ordinary incandescent lamp, and it was very curious to see the constant alterations in the readings with minute fluctuations in the current when the eye could perceive no change whatever in the lamp. The same firm also showed the seismograph, designed by Professor Ewing, and Mr. W. Duddell's oscillograph for tracing alternate-current wave forms. Another model in action that attracted considerable notice was Professor Dunkerley's machine to illustrate the whirling and vibration of shafts in rapid rotation. Among the railway exhibits may be mentioned examples of Mr. James Holden's liquid fuel burner for locomotives, as successfully used on the Great Eastern Railway; an interesting series of rail sections from Mr. W. Dean, illustrating the development of the permanent way on the Great Western; and a working model of a magnetic system of train signalling from Mr. W. S. Boult.

UNIVERSITY AND EDUCATIONAL NEWS.

THE gift of Mr. B. N. Duke, of the American Tobacco Company, to Trinity College, which we announced last week, makes his gifts to the College during the year $183,000; $6,000 of which is to improve the scientific laboratories.

The gifts of Mr. B. N. Duke and his father, Mr. W. Duke, to Trinity College have aggregated over half a million dollars in the last six years.

THE sum of twenty-five thousand dollars has been offered by an anonymous friend to Vassar College for a biological laboratory on condition another $25,000 be collected for the purpose.

BY the death of Mrs. Jeremiah Halsey the Norwich Free Academy will receive a bequest of nearly $100,000, and Trinity College, Hartford, $20,000, according to the provisions made by Mr. Halsey in his will.

THE Rev. H. Latham, Master of Trinity Hall, Cambridge University, has given £2,000 for the proposed Sedgwick Memorial Museum.

MISS SUSAN DYCKMANN has given $300 for a scholarship in zoology in Columbia University for the year 1899.

THE class of 1899 of the University of Pennsylvania has given the University $5,000 toward a scholarship in memory of the late Professor E. Otis Kendall, for many years professor of mathematics.

THE Thirty-seventh University Convocation of the State of New York will be held at Albany, beginning June 26th. President Harper, of the University of Chicago, will make the annual address, his subject being 'Waste in Education.'

AT the recent Commencement, on June 8th, the University of Nebraska conferred the following degrees:

Bachelor of Arts	84
Bachelor of Science	32
Bachelor of Laws	51
Master of Arts	14
Doctor of Philosophy	1

The degree of Doctor of Philosophy was conferred for work in mathematics, Dr. Engberg's thesis including a study of (1st) The Cartesian Oval, and (2d) An Extension in the Theory of the Characteristics of Evolutes. The following are the titles of the theses in science presented for the degree of Master of Arts:

'The Demagnetizing Effects of Currents in Iron when electro-magnetically compensated,' by Z. E. Crook.

'Beta-Phenyl-Meta-Nitroglutaric Acid and Derivatives,' by Mariel C. Gere.

'Studies on the Genus *Cittotænia*,' R. A. Lyman.

'A volumetric Method for the quantitative Estimation of Sulphuric Acid,' by Y. Nikaido.

'A Contribution to the Chemistry of Aromatic Glutaric Acids,' by H. C. Parmelee.

PROFESSOR BENJAMIN IDE WHEELER, who holds the chair of Greek and comparative philology in Cornell University, has been elected President of the University of California.

AT a recent meeting of the Board of Control of the Michigan College of Mines, Professor Fred W. McNair was unanimously elected President of the institution. Professor McNair has been for some years in charge of the department of mathematics and physics, and so closely identified with the work and growth of the College that its history, aims and methods are entirely familiar to him.

DR. F. STRONG, of Yale University, has been elected President of the University of Oregon.

MR. ULYSSES S. GRANT, of the Minnesota State Geological Survey, has been appointed professor of geology in the Northwestern University.

MR. FRANK R. LILLIE, instructor in zoology in the University of Michigan, has been appointed professor of biology at Vassar College. At the same College Miss Winnifred J. Robinson has been made instructor in biology and Miss Caroline E. Furness, Ph.D., assistant in the observatory.

AT Syracuse University, Mr. S. M. Taylor has been made associate professor of physics; Dr. Henry M. Smith, instructor in chemistry, and John G. Coulter, instructor in botany.

CARL A. BESSEY, A.B., and B.Sc. in Electrical Engineering, of the University of Nebraska, has been appointed assistant professor in the department of mechanic arts in the Agricultural and Mechanical College, Stillwater, Oklahoma.

FELLOWSHIPS at Bryn Mawr College have been given to Miss Elizabeth Towle in biology, and to Miss Anna L. Wilkinson in mathematics. The fellowship in physics has not yet been awarded.